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Flathead National Forest, Montana

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DAMAGE TO SPRUCE REGENERATION BY A TERMINAL WEEVIL, FLATHEAD NATIONAL FOREST MONTANA

By

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ABSTRACT

Leader killing of Engelmann spruce reproduction by a weevil, Pissodes strobi (Peck), has increased steadily in the Northern Rocky Mountain Region during the past 2 decades. By 1966, nearly all stands with spruce reproduction contained some weevil damage. Repeated attacks on the main bole of young spruce resulted in mortality in Emery Creek Plantation, Flathead National Forest; however, the majority of infested spruce suffered terminal kill. Trees 5 to 10 feet in height are most frequently attacked. Some parasites and predators are present but are not in great enough abundance to have a significant impact on the weevil population.

INTRODUCTION

Damage to Engelmann spruce, Picea engelmanni, by the weevil, Pissodes strobi (Peck) = engelmanni Hopk. (Smith and Sugden, 1969), has steadily increased during the past 2 decades in the Northern Rocky Mountain Region. Early reports of feeding by spruce weevil causing severe stunting of young spruce in Kishenehn Creek, Glacier National Park, were received in 1959 (Terrell, 1959). By 1966, nearly all areas of spruce regeneration in the Northern Region suffered some degree of weevil damage, and severe damage occurred in Upper Pinkham Creek, Kootenai National Forest, Montana (Tunnock, 1966).

Logging of mature and overmature spruce stands has resulted in increased planting of spruce. Weevil damage is becoming more noticeable with additional spruce planting. One of the heaviest spruce weevil infestations in the Northern Region occurs in the Emery Creek Plantation on the Flathead National Forest. The Emery Creek Plantation area was established during 1962-63. Approximately 536 spruce and 120 subalpine fir were planted. By 1967, it was estimated that about 30 percent of the leaders on the spruce were killed.

An evaluation was initiated in 1970 to measure the degree of damage caused by weevil infestations on spruce on the Flathead National Forest, and to obtain data on the parasite-predator complex affecting this insect.

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METHODS

A total of 224 trees varying from 1 to 30 feet in height were examined in the following areas: Alder-Good Creek drainages, North and South Fork drainages of the Flathead River, and in Emery Creek Plantation, Flathead National Forest; and Camas Creek Road and along McDonald Lake in Glacier National Park.

Damage measurements were taken to determine if weevils prefer to attack a specific age, height, or diameter size class. Age of trees was determined by counting branch whorls and adding 4 years. Number of years trees were attacked was determined by tabulating dead leaders per infested tree. Tree height was measured with an extendable forester's ruler, and diameter at base was measured with a diameter tape.

Infested spruce leaders were collected from Alder-Good Creek drainages and Emery Creek Plantation during August and October. Infested leaders were enclosed in 3-gallon ice cream cartons to recover adult weevils, parasites, and predators.

Roots of spruce killed by repeated Pissodes attacks in the main stem were found to be infested with coleopterous insects. Roots from seven dead spruce were collected and caged to recover insects feeding in the root system.

DAMAGE

Damage measurements were taken on spruce in the following areas: Emery Creek, 80 trees; Alder-Good Creek, 41 trees; North Fork Flathead River, 23 trees; South Fork Flathead River, 25 trees; Glacier National Park, 67 trees.

Pissodes strobi causes the following types of damage to young spruce:

1. Leader mortality (cover photo)
2. Tree mortality

Leader mortality results in deformity of the main stem. Repeated attacks cause multiple leaders and a bushy "cabbage-like" appearance of the tree. In addition, leader mortality may predispose trees to attack by secondary insects resulting in mortality of the entire tree. Repeated attacks on the main stem by P. strobi can eventually cause tree mortality.

Height of infested spruce ranged from 1 to 30 feet, average 10.0 feet. Age of infested trees ranged from 5 to 27 years, average 15.8 years. First attacks usually occurred when spruce were 5 to 7 years old. Graham (1926) reported that eastern white pine was first attacked by P. strobi when trees were 2 to 3 feet high and 5 to 7 years old. MacAloney (1943) found essentially the same as Graham, but also, when trees 2 feet high are attacked, they are usually killed back to the lowest whorl of laterals. If mortality did not occur, a scrubby tree resulted. Mortality occurred in trees girdled below the last whorl.

Of the 224 trees measured from all areas, 131 trees (59.0 percent) had one terminal killed; 63 (28.1 percent) had two visible dead terminals; 25 (11.1 percent) possessed three dead terminals; four (1.7 percent) had four dead terminals; and one (0.1 percent) had five dead terminals (Table 1).

Table 1.--Occurrence of weevil-killed terminals, Flathead National Forest, Montana, 1970.

Number of dead terminals	Number of trees	Percent of total trees
1	131	59.0
2	63	28.1
3	25	11.1
4	4	1.7
5	1	0.1
	224	100.0

One-half (50.0 percent) of weevil-attacked trees were in the 5- to 10-foot height class. Number of terminals killed were substantially fewer, but still heavy in the 10- to 15-foot tree class, and 0- to 5-foot height tree class (Table 2).

Table 2.--Infestation levels of Pissodes strobi by height class in Engelmann spruce regeneration, Flathead National Forest, Montana, 1970.

Height class (feet)	Percent of trees infested	Average number of attacks/tree
0-5	13.5	1.4
5.1 - 10	50.0	2.0
10.1 - 15	19.4	1.3
15.1 - 20	10.2	2.5
20.1 - 25	5.1	0.8
25.1+	1.2	1.6

The number of P. strobi emerging per infested terminal ranged from 0 to 49, average 11.9. Stevenson (1967) reported an average of 2.8 adult weevils emerged per infested leader in northern Idaho.

ASSOCIATED INSECTS

Natural Enemies

Only one parasitic wasp emerged from leaders collected during August in Emery Creek. Parasitism had probably just started, and collections at this time were made too early to obtain parasites and predators. Twenty additional infested leaders were collected from both Emery and Good Creek during October 1970 to obtain parasite and predator data. Six hymenopterous parasites and one dipterous predator were recovered (Table 3).

Table 3.--Parasites and predators[1/] recovered from weevil-infested spruce leaders in Emery and Good Creek drainages, Flathead National Forest, Montana, 1970.

Parasites and predators		Number collected	
		Good Creek	Emery Creek
	Hymenoptera		
Eurytomiidae:	Eurytoma pissodes Gir.	7	19
	Eurytoma sp.	2	0
Ichneumonidae:	Dolichomitus terebrans munilipennis (Vier)	0	26
	Dolichomitus sp.	1	0
Braconidae:	Bracon pini (Mues.)	22	20
Pteromalidae:	Rhopalicus pulchripennis (Cwfd.)	8	0
	Diptera		
Lonchaeidae:	Lonchaea sp.	0	27

1/ Identified by specialists, U. S. National Museum, Beltsville, Maryland.

The majority of parasites and predators of P. strobi overwinter inside infested terminals under the bark and in "chip cocoons." An estimate of the number of overwintering parasites and predators were obtained by dissecting infested terminals collected from Emery Creek during spring of 1967, 1968, and 1969. Results of dissections are shown in Table 4.

Table 4.--Results of dissections of weevil-infested terminals in Emery Creek Plantation 1967 through 1969.

Year	Terminals Dissected	Weevil population				Parasitic Hymenoptera (Number)	Predacious Diptera (Number)
		No. Emerged	Percent	No. Unemerged	Percent		
1967	17	364	66.9	284	43.8	29	107
1968	15	38	11.1	88	88.8	21	129
1969	9	32	11.4	88	88.5	33	208

Root Insects

The following insects were reared from roots of weevil-infested trees:

Coleoptera

Scolytidae:	*Dryocoetes autographus* Sw.[2/]
Curulionidae:	*Rhyncolus brunneus* Mann[3/]
Cerambycidae:	*Neoclytus muricatulus muricatulus* (Kirby)[3/]

Diptera

Lonchaeidae:	*Lonchaea* sp.[3/]
Dolichopodidae:	*Medetera aldrichii* Wheeler[3/]

Hymenoptera

Formicidae:	*Leptothorax muscorum* (Nylander)[3/]
Braconidae:	*Spathius cauadeusis* Ashm.[3/]

2/ Identified by Dr. Stephen L. Wood, Professor, Brigham Young University, Provo, Utah.

3/ Identified by specialists, U. S. National Museum, Beltsville, Maryland.

CONCLUSIONS

The weevil, P. strobi, is distributed throughout spruce stands of the Northern Rocky Mountain Region. Terminal killing is prevalent throughout many areas. Most serious damage occurs when repeated attacks on living portions of the main stem result in outright tree mortality, or predispose spruce to attack by secondary bark beetles or woodborers and mortality results.

Fewer attacks occurred on trees 20 feet in height and taller, and 21 years and older. Heaviest attacks occurred on trees from 5 to 20 feet in height. Damage and most widespread infestations occurred in open-grown stands. Weeviling has not been observed in understory of evenly stocked dense stands. In some areas, large blocks of young even-aged spruce offer ideal conditions for buildup and maintenance of weevil populations. This appears to be the trend in Emery Creek.

Effect of natural enemies in reducing weevil populations is not known. Stevenson (1963) reports that incidence of parasitism during late July when weevils commence to pupate ranged from 20 to 56 percent in southwestern Alberta and southeastern British Columbia. Parasitism of weevil populations on the Flathead National Forest from 1967 to 1969 was at a much lower level than reported for Canada.

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